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PROJECTS

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PET

Computer Review

Inside The Commodore PET

We don't feel that "Personal Electronic Transactor" completely describes it, but we liked what we found in this machine. Review by Graham Wideman and Mark Czerwinski

LOOK WHAT HAPPENS when an aggressive, popular-market calculator company joins forces with a low profile, high technology microprocessor manufacturer! Commodore and their mpu wing, MOS Technology, have come up with a product which while technologically unsurprising is revolutionary from a packaging and marketing point of view. Never before has a company tried to convince the public that a computer is an acceptable, fun, useful, perhaps even an essential thing to have around the house.

In the past it's happened with radios, TV s, automobiles, calculators, digital watches. We really are now seeing the introduction of the personal computer to widespread use.

We were dying to get some hands on experience, and managed to borrow one of the few (one or two) PETs that Commodore had in Canada. Here's the story, with some surprises!

IT'S COMING, IT'S ALMOST HERE . . .

No doubt many of our readers will have heard so much about this machine that they feel it's a little late to do a review and call it news. Certainly literature, advance press releases, tantalizing hints and the like have been with us for over six months, but the real machine is still only almost just arrived. A few words with MOS Technology in Pennsylvania put us in the picture.

By early December about 500 to 600 PETS had rolled off the assembly line, being produced at a rate of about 30 per day. These were almost all being shipped in the States and without complete manuals. A temporary manual was being issued, which contained little more than a description of BASIC, and a few elementary explanations for how to operate the machine. There was no sign of a complete manual in mid-December, nor much hope of its appearance within the near future.

As for sales of the PET in Canada, no one seems to know very much. The price fluctuates (mostly upwards) from week to week, and availability??? The price started at $695 and $895 (Canadian) for 4k and 8k models with delivery in January. At the time of writing (mid-December) the price is up to $850 and $1,100 for those same machines, and no CSA approval has been granted, which means no deliveries to consumers. A couple of machines have appeared in very eager stores, but these outlets can still only accept orders.

In view of the low speed of production, and the incredible demand we expect will have developed for this equipment, it is likely that the US demand will exhaust most of the supply and Canadians will have a long wait. March is our optimistic guess for first delivery, but then it's just a guess.

THE MACHINE ITSELF

The actual, non-imaginary, not-just-promised hardware we borrowed is pictured on the cover. We have several assurances that what's in that one is what you'll get if you order one. It does

Fig. 1. An "old" (and not very good) Commodore press release photo. Note rounded case.

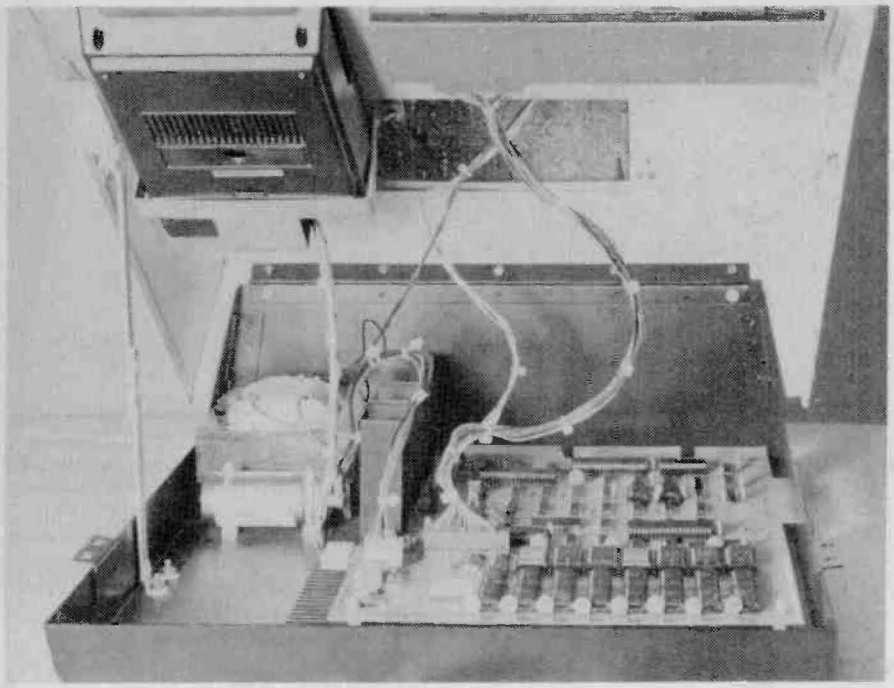


Fig. 2. Our first sight of the insides. It's a real pleasure to open it up and discover a "prop" already in place to hold up the top. Notice neat cabling and connecting plugs, making for cheap efficient assembly and service.

however look significantly different from that pictured in Fig. 1., chiefly in case styling, recessing of the keyboard, and cassette deck. In addition the keyboard in Fig. 1. has completely different graphics symbols. In any case (?), it appears that our model is closer to a production machine, or may even be one, having regard to the fact that dates inside indicate it was built in early October, and the main pcb is numbered 0109. The cassette worried us a little though (see below).

So what do you get? Basically, what you see, and a few other features. Inside is a microprocessor system, and it's hooked up to an alpha-graphics keyboard, numeric-and-more graphics keyboard, CRT display, and cassette recorder. The microprocessor system uses the (big surprise) MOS Technology 6502 mpu, with 14k of ROM containing everything to operate the hardware, and purportedly a very fast interpreter for BASIC. As stated above 4k or 8k of RAM is provided for user program and data storage.

HOW DID WE LIKE IT

There is no doubt that this package of micro-pieces is well thought out, and designed with the idea that the user needs to know very little about computers to get "into" the PET. Remember the increased popularity of tape recording when cassettes came out? Make it simpler to use, easier for the human being. Same philosophy at work here, and that is what will sell it. Needless to say in spite of the fact we had very little documentation, we were highly impressed.

First of all there is no wiring up to do. When you plug in and switch on the PET, after only a couple of seconds it's ready for action. No BASIC to load from tape, it's already in there. This is one great headache reliever if the program you've written bombs out and writes all over memory in selected vital (of course) locations. No waiting for a 20 minute BASIC reload. 14k of built-in software is worth ten times its weight in silicon.

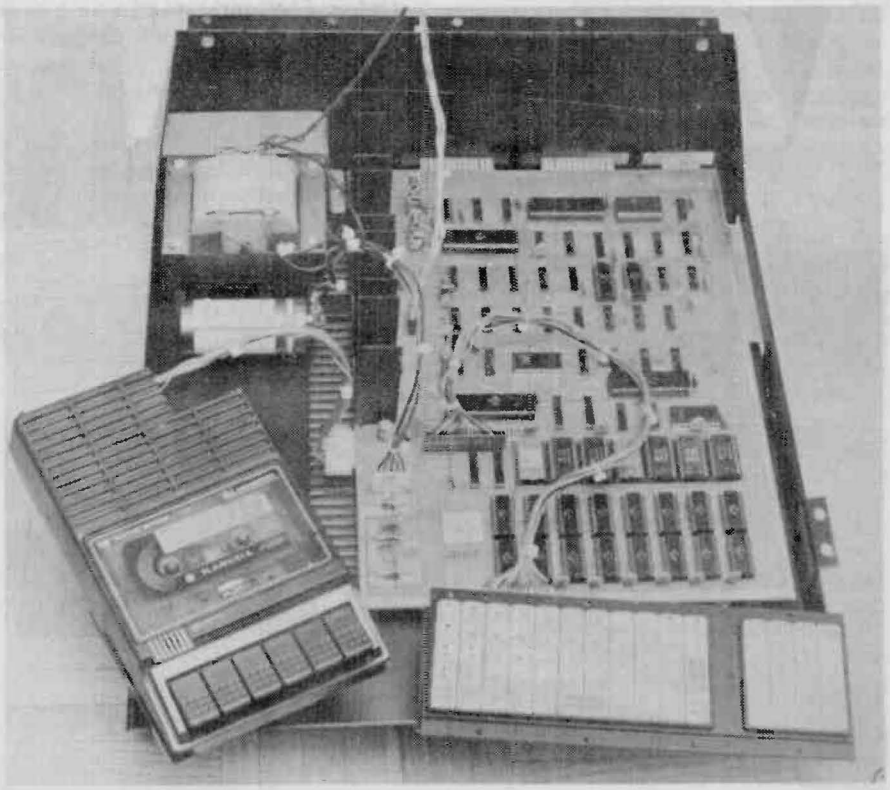
So after "power up" you can start programming, (more about that under SOFTWARE) or load from a cassette the software you want. Presumably in the future, tapes for various useful software packages will be widely available, so you will infrequently *need* to write your own, but it's lots of fun so you'll actually want to.

TAPED

Upon entering the LOAD instruction, the machine tells you to stick the tape in and press the "PLAY" button. Here's where a compromise has been made. Although the PET can switch the transport motor on and off, it tells you to do the muscle work. Commodore have saved money by using a standard (cheap) cassette recorder, which is sensible for the consumer market they are aiming at. In fact, as you can see in Fig. 3., our cassette was so standard it had a grille for "condenser mike", and the corner had been somewhat roughly cut off for the wires to enter its body.

The cassette feature worked quite well, although a couple of demonstration tapes did not load properly (we suspect over-worn tapes due to heavy

Fig. 3. Here we've detached some of the parts from their mountings so we didn't have to draw a block diagram. Video monitor board is above.



use). One feature we would have liked, (which could not have been included without a large extra cost) would be a fast forward search. Without it the machine took a long time to find a program if the tape was started at the beginning and the program happened to be near the end. For this reason it seems most economical (time wise) to only use C30 cassettes (these are thicker and stronger anyway) and then record only one or two programs near the start of each side, unless programs are recorded in some long sequence in which they are to be used, or for storage of little used data etc.

KEY FEATURES

Another cost saver is the keyboard, being of calculator type construction and feel. An idea of its size and action may be gathered from Fig. 5. All our reviewers disliked the feel (no feedback, you have to look at the screen to see your entry) particularly since we had a lot of problems with a reluctant "N". On the other hand these reviewers were all used to sitting down at expensive IBM terminals for days (and nights) on end, so perhaps the comments are unfair.

The keyboard arrangement has all the rows of keys lined up instead of offset as in a normal keyboard, which would appear to be a big disadvantage to experienced typists. However, one is unlikely to enter vast quantities of text, and this turned out to be less annoying than anticipated.

To solve all these problems, it would be a simple matter to replace the main keyboard with a "proper" one. Since there are no electronics inside, it would simply be a question of configuring the switches the same way. How long will it be until some one comes out with a PET soup-up kit, come on, we've started counting . . . !

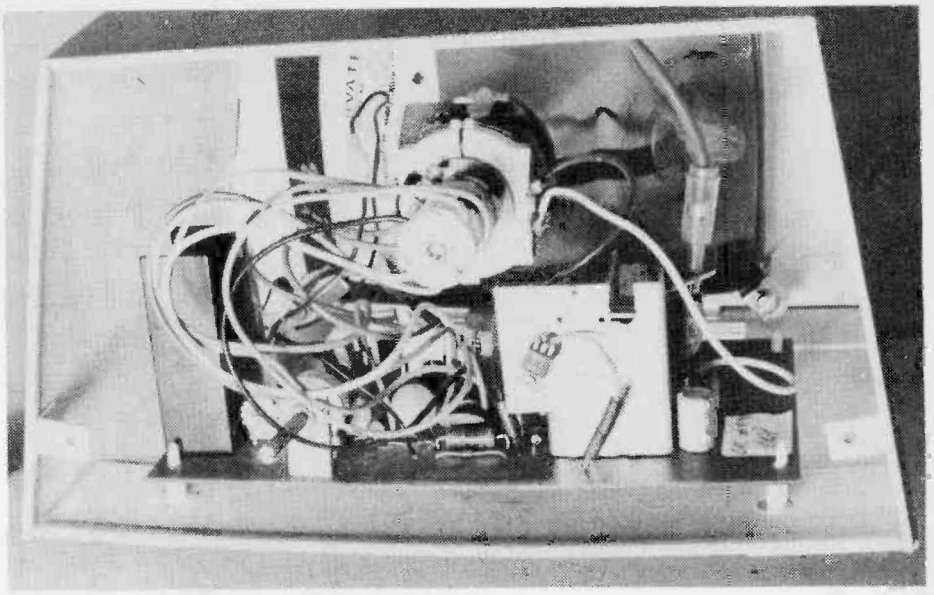


Fig. 4. Peeking in the back of the video monitor reveals a fairly standard set of works.

A CRT-ICAL LOOK

The video monitor appears to be quite standard, Fig. 4 is a view in the back. The 9 inch CRT provided us with high resolution for the 25 lines of 40 characters. A brightness control is located at the rear.

ELECTRONICS

For the electronics enthusiasts (well, you're reading this magazine, aren't you?) we've got Fig. 6. Most of the important features are shown on this photo, from which a basic idea of the system configuration can be gleaned. All the big chips are plugged into sockets, something nice to see, especially for ROMs. (When's APL coming???)

Commodore appears to be producing mostly, if not exclusively 8k models at the moment, but the hefty ($250) price difference between 4k and 8k models means that it could be significantly cheaper to buy a 4k model and plug your own 4k worth of RAM into the sockets, or holes, left vacant. No doubt 4k buyers will be offered the option of having an extra 4k installed later, and they may as well save by doing it themselves. In addition, a planned option is a 24k memory unit with its own power supply, to connect onto the expansion connectors. Commodore literature says this unit "cannot be described as static or dynamic but somewhere between the two". This we take to mean dynamic memory chips with additional hardware to handle the refresh independently from the PET. This would allow simple interface, servicing, and great savings in the power supply using low power cheap dynamic RAMs. The 6502, like 6800 does not use the entire clock cycle, thus allowing (through suitable synchronizing circuitry) memory refresh to occur in the unused part of the cycle. Clever and cheap; economy attainable in such a large memory unit.

The keyboard is accessed via a 16 line Peripheral Interface Adapter (6520 like a 6820 for Motorola fans) which we expect uses 8 outputs and 8 inputs for decoding 64 keys, and then also a couple of the PIA "handshaking" lines for the rest of the work. In other words most of the keyboard decoding is done by software.

The cassette recorder as previously mentioned is a customised standard one, with a new pcb inside full of electronics suitable for data recording.

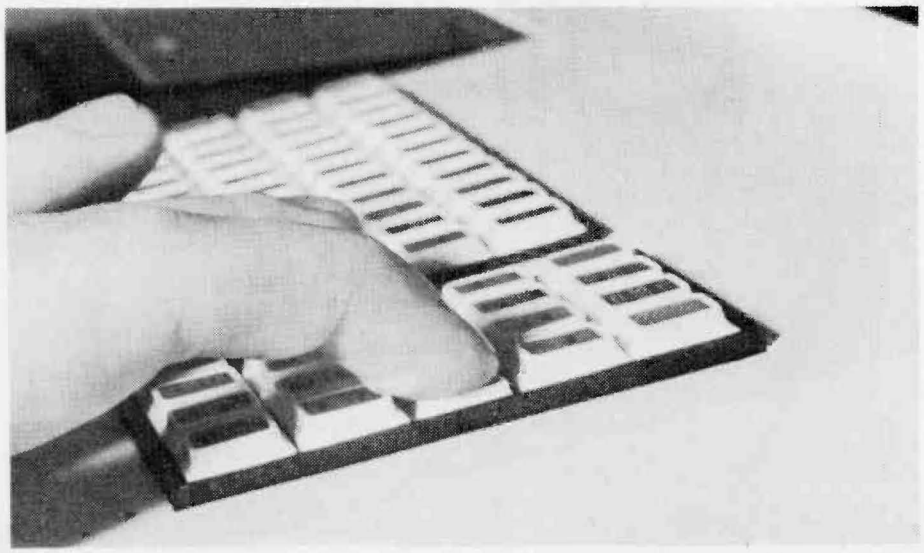


Fig. 5. We call this one "Finger on the key of '". Portrays finger pushing down key all the way to illustrate keyboard action.

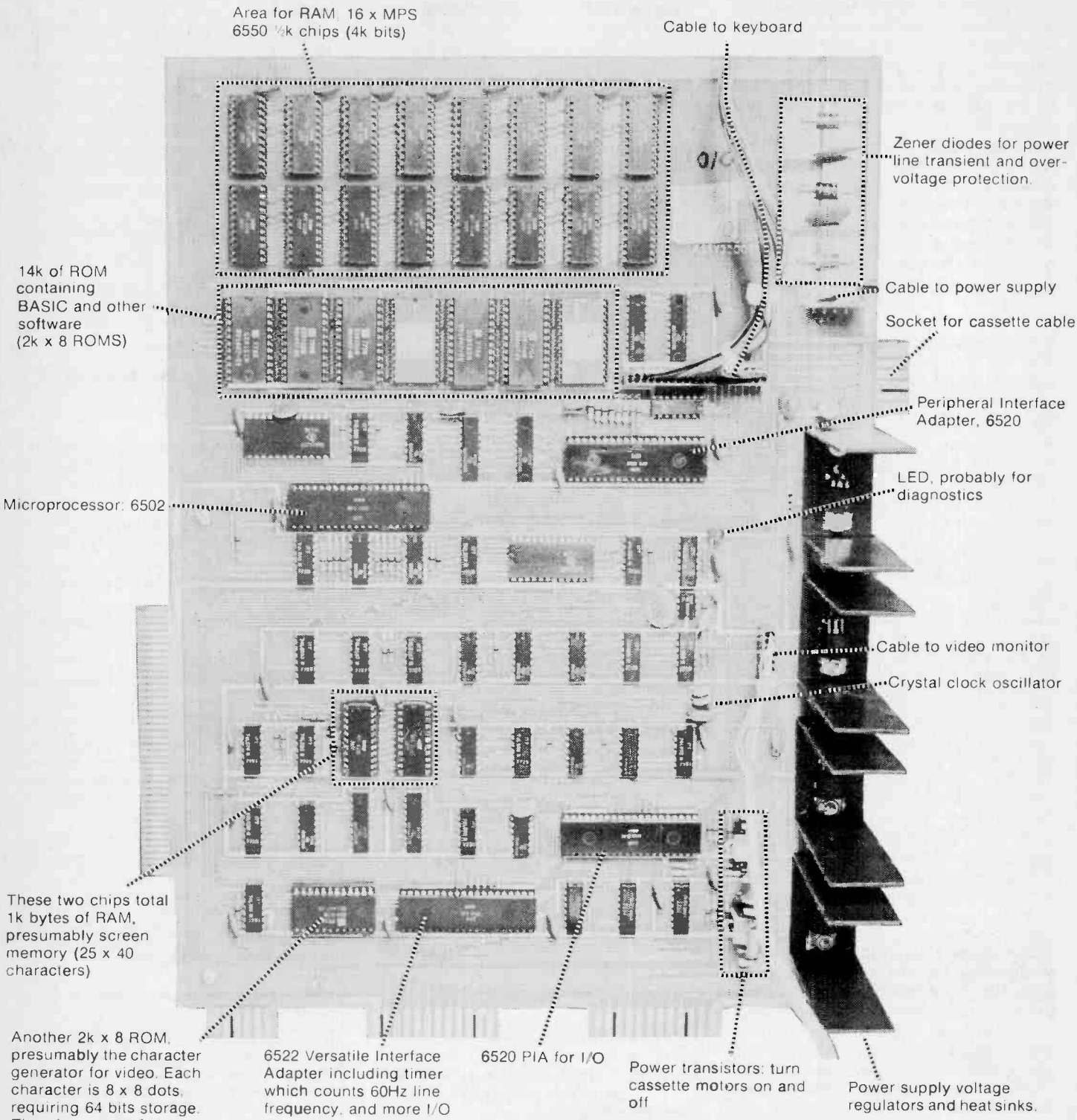


Fig. 6. This is the main PET board, containing all the electronics except for video monitor and cassette circuitry. Note well thought out layout, and edge letters/numbers for easy location of areas on the board.

In fact two cassette interfaces are included (second cassette recorder available for about $100.00 sometime) with input, output, and motor on/off lines. This uses six lines of the 16 on the second 6520 PIA (we assume) leaving 10 lines, 8 for parallel I/O, and 2 serial, at TTL levels. Both cassettes record at 1000 baud, but using built in software any program is recorded twice in series for reliability, cutting the effective rate to 500 baud. Thus an 8k program takes about 2½ minutes to load.

In addition, the PET is probably the first popular micro-computer to use the IEEE 488 bus for instrumentation communications, making it compatible with many existing and future digital instruments, printers etc. Commodore themselves plan to hang

on this a printer ($1,000.00?), floppy disc (mini $1,000.00, "full size" $2,000.00??) and telephone interface ($?) available when we don't know, but with a standard bus you can be sure there will be a swarm of cheap add-ons from other sources in the not too far future, just like when the S100 bus caught on.

A final note of the hardware. Unlike some of the early hobby computer equipment the inside of this machine looks like it's built for business, and for the manufacturer to stay in business. Constructed with quality electronics, and chassis and pcb arrangement for easy assembly and service.

SOFTWARE

As stated before, one of the beauties of the PET is its built in ROM — full of software. The 14k includes 8 k BASIC, 4k Operating System, 1k Machine Language and 1k Diagnostic routine, according to Commodore's literature.

First there's 8k of "extended" BASIC. The correct term is "BASIC interpreter". In simple terms an interpreter is a machine language program which takes your BASIC program as data, "translates" it to machine language subroutines and then executes it. This process actually occurs in a line-by-line translate-execute manner. The term "extended" refers to the fact that many statements are included that are omitted in some versions of BASIC. Using BASIC means that programming can be conducted in a civilized manner, using statements that are almost readable in English, with base ten numbers. The machine does the work of converting to machine language and 8 bit binary arithmetic. As encouragement to skeptics we've included a description of the language and how (easy it is) to use it.

Commodore claim that their BASIC is significantly faster than anybody else's which we cannot attest to, but for general use the PET performed admirably as compared to the reasonably typical IBM 360 and 370 interactive, multi-user systems that the reviewers were familiar with. (But we do like APL!)

The cassette I/O, keyboard, video, and other functions are handled by the 8k operating system.

Lacking documentation, we can only guess at the other two ROM items. The diagnostic routine we assume verifies the operation of the hardware, and uses the LED as an indicator for this task.

The 1k machine language we guess refers to an assembly language ("machine language" is what the mpu uses, "assembler" is one step higher, using mnemonics for each instruction, and is generally more readable and useable). There is also a mention of next year's "assembler device", to be plugged into the expansion port for "machine language" (?) programming. The advantage of machine or assembler language programming is increased efficiency of programs over those "interpreted" from BASIC. This could be critical in case of a routine which runs several thousand times in a loop, or for a frequently used function.

BASIC BASIC (INTERACTIVE)

One can think of the PET as operating in one of two modes: "calculator mode" in which the operator asks the machine to execute and give the results of one statement; and "programmed mode" in which the programmer enters a series of statements, then has the machine execute the entire set at one go. The second mode requires a little more structure for "administrative" purposes.

A list of the available statements and commands with comments may be found to the right for reference.

CALCULATOR MODE

Known by this name because it is the process of getting a quick answer from a small formula, (similar to calculators), or telling the machine to do one thing.

Example: PRINT 3+4

The machine works out 3+4 and "prints" the result on the screen.

Another example: LOAD FRED

This causes the machine to obtain a program called "FRED" from the cassette, including giving you instructions about what buttons to push on the recorder.

PROGRAM MODE

Problem: Figure out the sum of the integers zero to ten.

```
Program: 10 J% = 0
         20 FOR I% = 1 TO 10
         30 J% = J% + I%
         40 NEXT
         50 PRINT J%
         60 END
```

The numbers down the side are line numbers which can be any integers, and they keep the lines in order. We have chosen multiples of ten as it makes for easy editing at a later date by inserting line numbers in between if necessary. The variables are J% and I%. The % signs identify them as integers.

The FOR — NEXT pair signify a "loop" to be executed many times. The first time I% has the value 1, the second time 2, and so on up to 10.

On each iteration the value of I% is added to the accumulated total J%. After the 10th interation the program continues to line 50, prints the answer, then stops at 60. A simple task, a simple

BASIC

Commodore claims that their full floating point BASIC is the fastest yet implemented on a microcomputer. Here are the statements and features included.

Standard Dartmouth BASIC Statements: LET, READ, PRINT, DATA, IF, THEN, FOR, NEXT, DIM, END, GOTO

Extended BASIC Statements: RESTORE, REM, GET, GOSUB, DEF, RETURN, STOP, STEP, INPUT, FN, ON . . . GOTO, ON . . . GOSUB

Scientific Functions: SGN, INT, ABS, SQR, RND, SIN, COS, TAN, ATN, LOG, EXP, PI

Logical Operators: AND, OR, NOT

Operation Commands: RUN, NEW, CLR, LIST, CONT, FRE

Formatting Functions: TAB, POS, SPC

Machine Level Statements: PEEK, POKE; Allow the user to examine and store at specific memory locations. USR, SYS; Link BASIC to machine language subroutines with parameter passing or developmental subsystems. WAIT; Monitors status of a memory location such as an I/O port until specified bits are set.

String Functions: LEFT$, RIGHT$, MID$: Returns substrings (of specified length and position) of string acted upon. CHR$, ASC: CHR$ returns a character, given a numeric code. ASC returns a numeric code corresponding to a character. LEN: Returns the length of a string. VAL, STR$: Convert decimal values to numeric strings and vice-versa.

Extended I/O Statements: OPEN, CLOSE: Control association of a logical file number to a physical device and, optionally, a file name on the device. SAVE, LOAD, VERIFY: Store and retrieve a program, with optional file name, on a physical device. Load allows for program overlay, VERIFY compares contents of memory to stored program. PRINT#, INPUT#, GET#: Allow communication with logical device numbers other than keyboard or screen. GET# inputs one character. CMD: Permits communication with multiple devices simultaneously.

Variables
TYPES: Real, Integer (%), String ($)
NAMES: Variable names are uniquely given as a letter or a letter followed by a letter or digit.

Special Variables
TI, TI$: Time of day. ST: Status word for I/O operations.

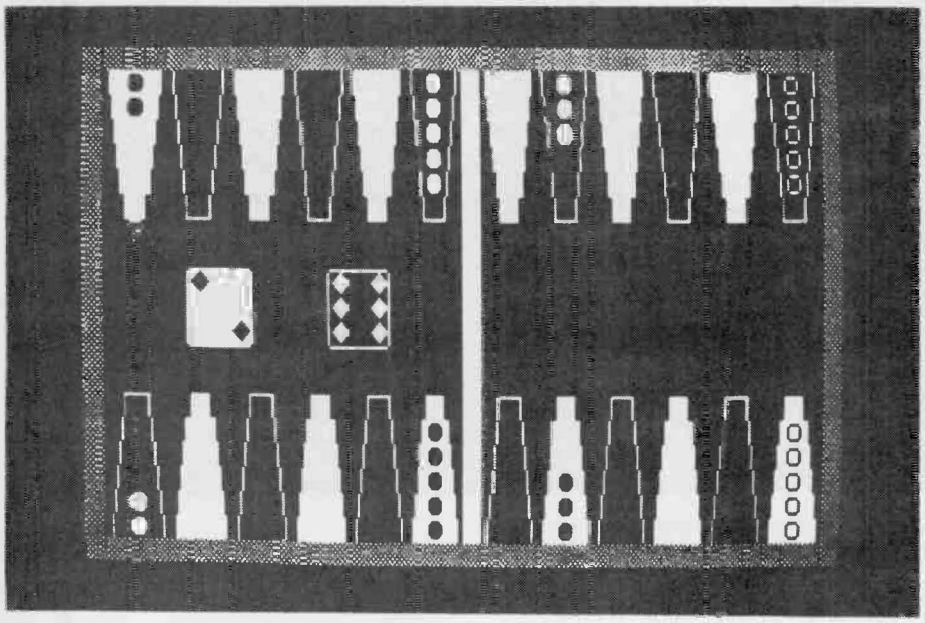


Fig. 8. The PET's impressive array of graphic symbols makes game playing or creating quite a pleasure.

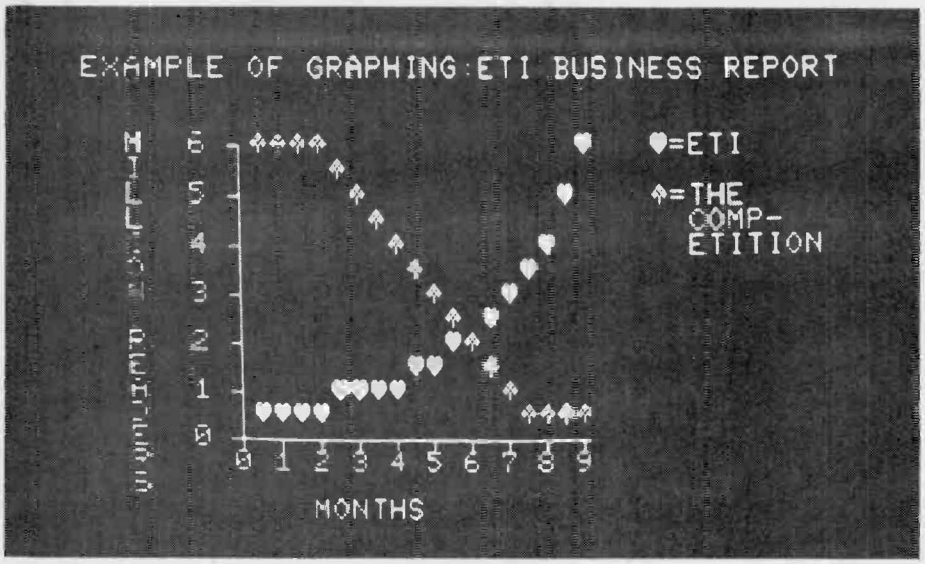
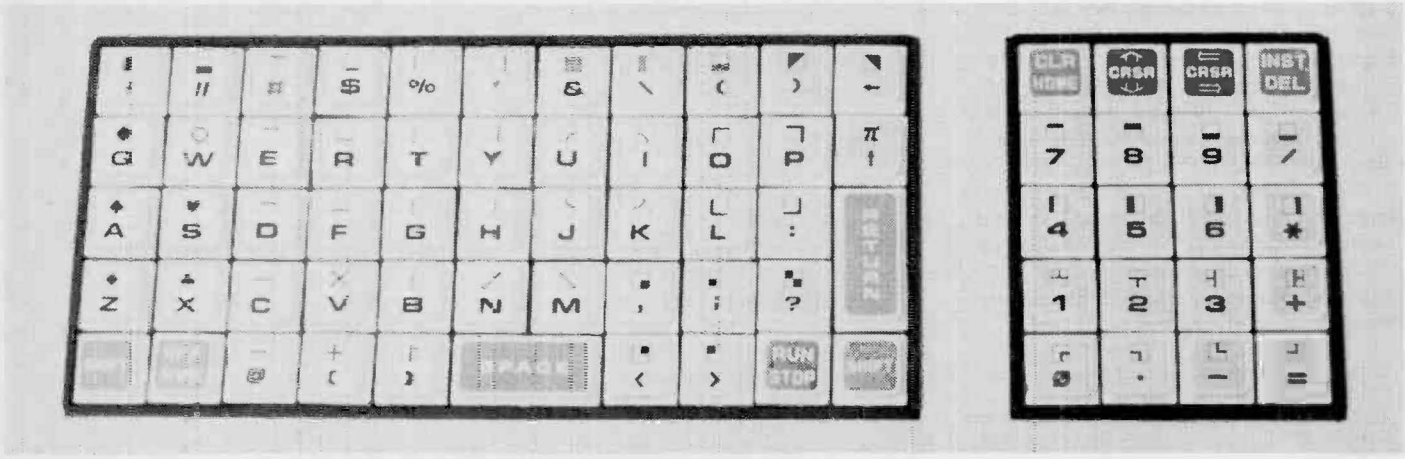


Fig. 9. We were even more impressed when we saw the machine produce this graph!

Fig. 7. The two PET keyboards. We found it quite handy to have a separate numeric pad having hassled with other arrangements on interactive terminals and keypunch machines.



program. With the program stored in the machine, the operator keys in "RUN" and the answer appears. How boring. But it does illustrate the ease of programming.

Of much more interest to people are fun programs like games, and business software which helps you make (more) money. These can also be simple, or of complexity running to many hundred statements. These programs not only do simple calculations, but manipulate character data, set up filing systems on tape, draw fancy graphics on the screen and other entertaining activities. And you can exercise your imagination writing your own programs. A computer can be a very creativity promoting toy, requiring very little activation energy (other than original outlay) to get you involved, alot more healthy than a TV set, that's certain!

GRAPHICS

We suspect some pretty creative, intelligent people sat down and worked out the graphics character set on this machine. Figure 7 shows the keyboard and all the characters you can key in.

The display system is based upon 8×8 dot units, which may contain 5×7 dot upper case letters, or assorted symbols which are so designed to provide very versatile diagram and graphing capabilities. Because the 8×8 blocks fit together both horizontally and vertically, it means that adjacent lines of text look a little crammed together, but this can be avoided by judicious line spacing if necessary.

Commodore PET

The "cursor" is a flashing "element" or character that can be moved about the screen, and it normally indicates the next space to be typed in. After typing in that space the cursor moves to the next adjacent spot and so forth. "RETURN" causes the cursor to move to the first position on the next line, just as a carriage return does on a typewriter. Additional cursor control is provided to move it quickly up, down or sideways. The cursor is useful also for editing and correcting programs already written on screen, with the facility for inserting and deleting characters. When the cursor attempts to move below the bottom of the "page", the screen "scrolls up". That is to say each line moves up one, with the top line disappearing.

In addition to the normal characters, each may be "reversed", that is appear as black on white, which can be used to advantage on some occasions.

Finally, here's our big surprise! If you've been counting keyboard characters, there are alot less than the 256 possible with the character generator shown in Fig. 6. Quite by accident we found a whole set of lower case letters! Very interesting. We're not quite sure what does it but check the pictures for yourself. That still doesn't add up to 256 characters, so there may be yet more we don't know about. In fact our Fig. 1 photo, upon close scrutiny of the keyboard shows another set of graphic symbols including assorted Greek letters, could they be inside as well? We don't know, but it all depends on what's in the character generator. We wonder if Commodore has lower case letters planned as a future "add-on option?" For that matter you could always burn your own PROM . . .

WHAT MORE CAN WE SAY?

It looks like computers are starting their march into the homes of the masses, which sounds very science-fiction and scary to some. We hope that the familiarity with computers this may bring to the man/woman/child in the street will reverse the widespread fear of THE COMPUTER as an enemy. Perhaps man will once again feel master over objects. There was after all a time when the automobile was regarded as an evil fire breathing monster, until everybody got one.

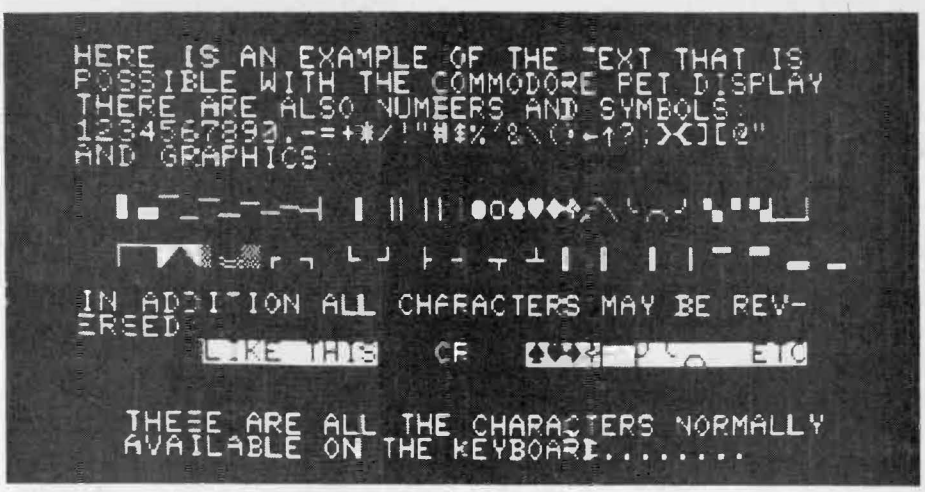
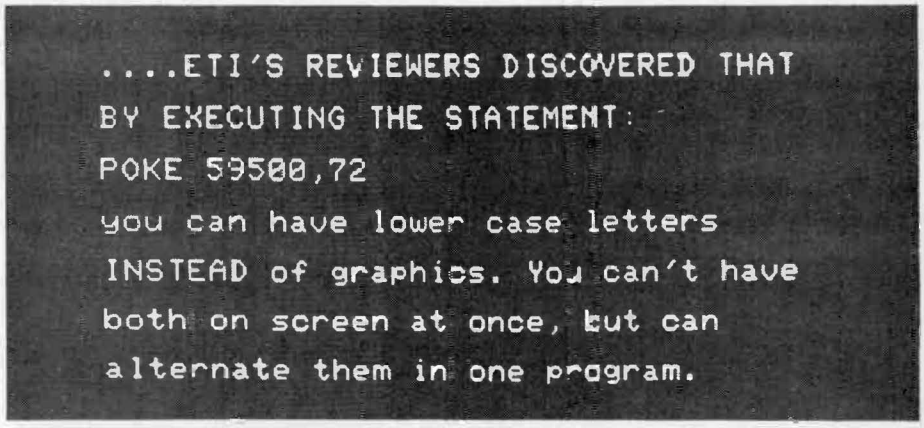


Fig. 10. Text can look a little cramped as the lines of capital letters are quite close. It's designed that way so that the graphic symbols will join together.

Fig. 11. OK, we'll have to admit it was luck, but there they are, lower case letters and how to get them. Go and impress your local PET dealers. Don't forget to tell them where you read it . . .



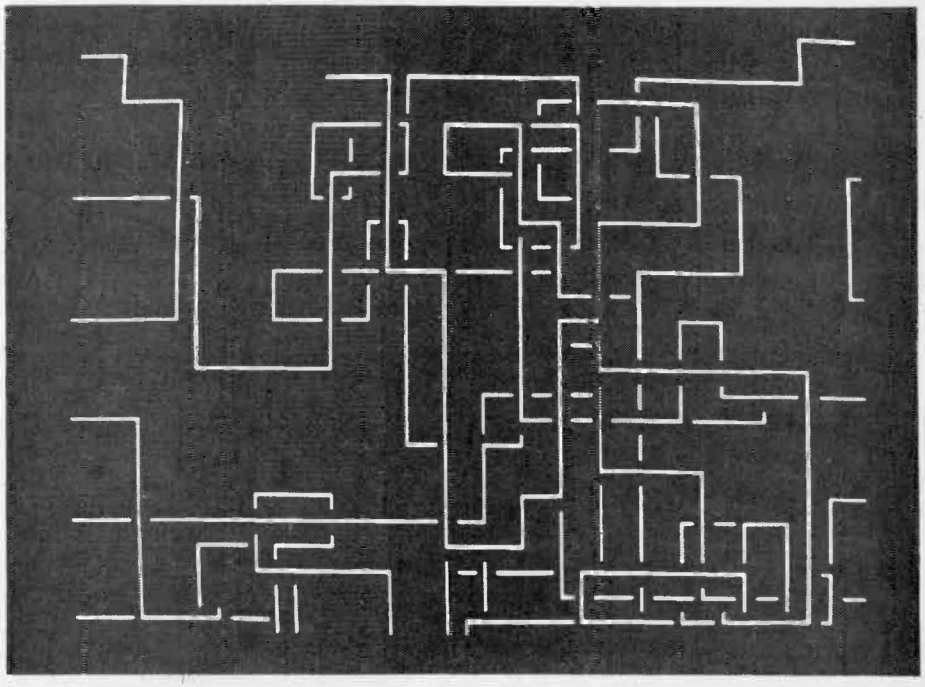


Fig. 12. No kidding, we really turned our machine into a labour saving device, designing our pcb layouts for us!!! Any errors in future . . . "Well, it was the computer's fault".